GRC Series

SCPD3
SCM
SSD2
MDC2
SMG
LCM
LCR
LCG
LCX
STM
STG
STR2
MRL2
GRC
Cylinder switch
MN3E MN4E
4GA/B
M4GA/B
MN4GA/B
F.R (module unit)
Clean F.R
Precision R
Press gauge Diff. press gauge
Electro-pneumatic R
Speed controller
Auxiliary valve
Fitting/ tube
Clean air unit
Pressure sensor
Flow rate sensor
Valve for air blow
Ending

Selection method

Select based on the following procedures.

Step 1 Oscillating time confirmation

↓

Step 2 Select the size (torque).
(1) Static load
(2) Resistance load
(3) Inertia load

↓

Step 3 Allowable energy confirmation

↓

Step 4 Allowable load confirmation
(1) Thrust load
(2) Radial load
(3) Moment load

Step 1 Oscillating time confirmation

If the oscillating time is set outside of the specified range, the actuator's operation may become unstable, or the actuator could be damaged. Always set the oscillating time within the specified oscillating time adjusting range.

	Using with 90°	**Using with 180°**
Oscillating time (s)	0.2 to 1.5	0.4 to 3.0

Step 2 Size (torque) selection

Selection method is roughly categorized into three load.
In each case, the required torque must be calculated. If the load is a compound load, add each torque to calculate the required torque.
Select size from theoretical torque table or actual torque diagram per working pressure to meet required torque.

(1) Static load (Ts)
When static pushing force is required for clamp, etc.

$$T_S = F_S \times L$$

Ts : Required torque (N·m)
Fs : Required force (N)
L : Length from center of rotation to pressure cone apex (m)

(2) Resistance load (TR)
When forces caused by frictional force, gravity and another external force are applied.

$$T_R = K \times F_R \times L$$

TR : Required torque (N·m)
K : Margin factor with $\begin{cases} \text{no load fluctuation: } K = 2 \\ \text{load fluctuation: } K = 5 \end{cases}$
FR : Required force (N)
L : Length from center of rotation to pressure cone apex (m)

(3) Inertia load (TA)
to rotate object

$$T_A = 5 \times I \times \dot{\omega}$$
$$\dot{\omega} = \frac{2\theta}{t^2}$$

TA : Required torque (N·m)
I : Moment of inertia (kg·m^2)
$\dot{\omega}$: Maximum angular speed (rad/s^2)
θ : Oscillating angle (rad)
t : Oscillating time (s)

Calculate moment of inertia using moment of inertia and oscillating time (page 299) or the figure for moment of inertia calculation (page 300).

Step 3 Allowable energy confirmation

When using an inertial load, if the load's kinetic energy exceedsthe allowable value at the oscillating end, the actuator could bedamaged. Select one within allowable energy according to Table 1.
If energy is too large, stop load with external shock absorber, etc.

$$E = \frac{1}{2} \times I \times \omega^2$$
$$\omega = \frac{2\theta}{t}$$

E : Kinetic energy (J)
I : Moment of inertia (kg·m^2)
ω : Angular speed at the end of oscillation (rad/s)
θ : Oscillating angle(rad)
t : Oscillating time (s)

Calculate moment of inertia using moment of inertia and oscillating time (page 299) or the figure for moment of inertia calculation (page 300).
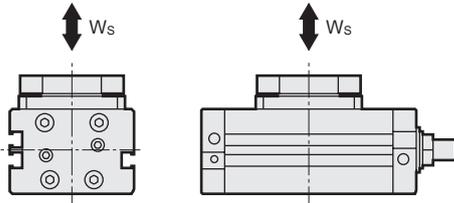
CKD

Selection method

Step 4 Allowable load confirmation

If the load directly applies to the table, it should be within the allowable range in Table 2.
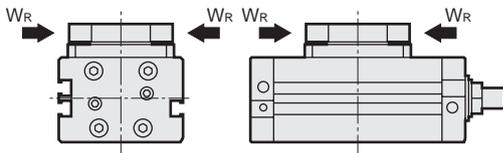
If a combined load applies, the total of the ratio for allowable value per load should be 1.0 or smaller.

Load can be grouped into the following three types.
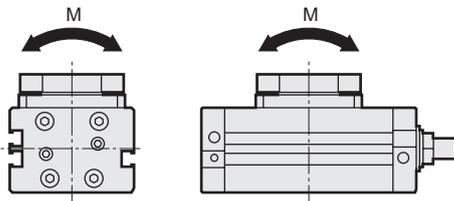
(1) Thrust load (axial load)

(2) Radial load (lateral load)

(3) Moment load

Calculate each type. Then, assign the values into the following formula.

$$\frac{W_S}{W_{Smax}} + \frac{W_R}{W_{Rmax}} + \frac{M}{M_{max}} \leqq 1.0$$

W_S	: Thrust load (N)
W_R	: Radial load (N)
M	: Moment load (N·m)
W_{Smax}	: Allowable thrust load (N)
W_{Rmax}	: Allowable radial load (N)
M_{max}	: Allowable moment load (N·m)

Allowable absorbed energy and allowable load are shown in the following table.

Table 1 Allowable absorbed energy value   (J)

Size	5	10	20	30	50	80
Basic/high accuracy	0.005	0.008	0.03	0.04		0.11

Table 2 Allowable load $W_{Smax.}$ $W_{Rmax.}$ M_{max}

Size		5	10	20	30	50	80
Thrust load W_{Smax} [N]	Basic	50	80	140	200	450	580
	High accuracy	-	120	220	440	550	650
Radial load W_{Rmax} [N]	Basic	30	80	150	200	320	400
	High accuracy	-	100	160	240	380	480
Moment load M_{max} [N·m]	Basic	1.5	2.5	4.0	5.5	10.0	13.0
	High accuracy	-	3.0	5.0	7.0	12.0	15.0

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F.R.(module unit)
Clean F.R
Precision R
Press gauge Diff. press gauge
Electro-pneumatic R
Speed controller
Auxiliary valve
Fitting/ tube
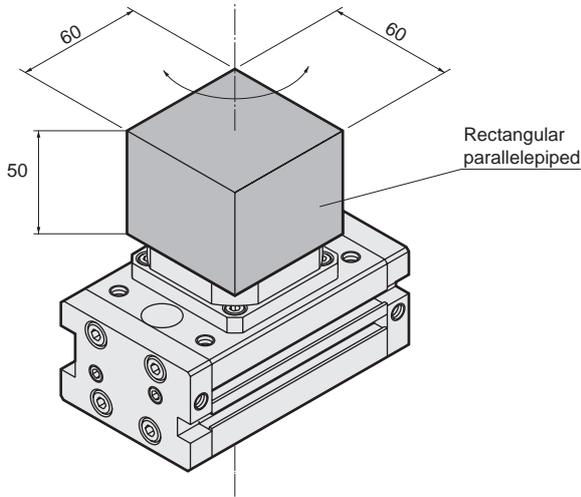Clean air unit
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Ending

Selection example

When rectangular parallelepiped load is applied

Rectangular parallelepiped

[Operation conditions]
Pressure : 0.5 MPa
Oscillating angle : 90°
Oscillating time : 0.6 s
Load (material : aluminum alloy)
[Rectangular parallelepiped] : 0.5 kg

Step 1 Oscillating time confirmation

Oscillating time is 0.6 (s/90°) according to operation conditions. Since oscillating time is within adjusting range 0.2 to 1.5 (s/90°), go to next step.

Step 2 Select the size (torque)

First, calculate the moment of inertia (I) due to inertia load.
[Rectangular parallelepiped]

$$I = 0.5 \times \frac{0.06^2}{6} = 3 \times 10^{-4} \ (kg \cdot m^2) \quad \ldots\ldots(1)$$

Then, calculate the maximum angular speed ($\dot{\omega}$).

Based on the conditions $\theta = 90° = \frac{\pi}{2}$ (rad), t = 0.6 (s)

Therefore,

$$\dot{\omega} = \frac{2\theta}{t^2} = \frac{\pi}{0.6^2} = 8.73 \ (rad/s^2) \quad \ldots\ldots\ldots(2)$$

Therefore, inertia load (T_A) from (1) and (2)

$T_A = 5 \times 3 \times 10^{-4} \times 8.73$

$= 0.0131 \ (N \cdot m)\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(3)$

According to (3) value and operational conditions and torque at 0.5 (MPa)

GRC-5-90 ……………………………..……(A) is selected.

Step 3 Allowable energy confirmation

Calculate the kinetic energy. Check if the value is within the allowable energy range.
Calculate the angular speed at the end of oscillation ω.

Based on the conditions $\theta = 90° = \frac{\pi}{2}$ (rad), t = 0.6 (s)

Therefore,

$$\omega = \frac{2\theta}{t} = \frac{\pi}{0.6} = 5.24 \ (rad/s)$$

Therefore, kinetic energy (E) is

$$E = \frac{1}{2} \times 3 \times 10^{-4} \times 5.24^2$$

$= 0.00412 \ (J) \quad \ldots\ldots\ldots\ldots\ldots\ldots(4)$

From (4) and (A) selected in Step 2

GRC-5-90 ………………………………..…(B) can be selected.

Step 4 Allowable load confirmation

Finally, calculate the load applied to the table. Check if the value is within the allowable range.
[Thrust load]
Thrust load (W_s),
$W_s = 0.5 \times 9.8 = 4.9 \ (N) \quad \ldots\ldots\ldots\ldots\ldots(5)$
[Radial load]
Since no radial load exists,
$W_R = 0 \ (N) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(6)$
[Moment load]
Since no moment load exists,
$M = 0 \ (N \cdot m) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$
According to (5), (6), (7), and (B)

$$\frac{W_s}{W_{smax}} + \frac{W_R}{W_{Rmax}} + \frac{M}{M_{max}}$$

$$= \frac{4.9}{50} + \frac{0}{30} + \frac{0}{1.5} = 0.098 \leqq 1.0 \quad \ldots\ldots(C)$$

the total load value is within the allowable load range according to (B) and (C). Hence,

GRC-5-90 is selected.

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